Cement MILL SECTION of

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From a Rumanian Cement Mill

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As the editor of this magazine, Concrete, put it to the writer some months ago, it might be of some interest to American cement mill men to come in some closer contact with the professsional men on this side of the great pond and exchange views upon the diverse common and pendent problems. Perhaps in the following lines the mill man may find some points worth while the reading.

As in 1908 the Hungarian government was prospecting for potash salts in Transilvania, the prospecting engineers struck upon some feeble traces of natural gas drilling in a depth of about 20 meters. Going farther to about 200 meters—and with the greatest difficulties to about 300 meters—they came upon natural gas in enormous quantities and with a pressure (about 30 atmospheres) as to make them stop the drilling. The natural gas—quite a new thing for these regions—they didn't know how to stop and govern, and from the corehole about 8,000,000 cubic meters of gas thundered and roared daily in the free air for quite a long time.

At last the necessary devices were found, but what to make with the new riches was now the pendent question, the Hungarian government and capital being none too eager to take their opportunity.

Some foresighted private company men then ventured upon the risk and in 1911 the Solvay works and the Torda Cement Works Co. floated the First Transilvanian Natural Gas Conducting Co. and started the construction of a high pressure conduit from the gas wells to Torda, the little Transilvanian town, with about 15,000 souls, where the natural gas was to be used in existing plants and plants to come.

The conduit, about 50 kilometers long and built of 250 mm. high pressure steel tubes, was finished in 1914 and the erecting of the Torda cement works was immediately started.

And then came the war—the "world war" as we are saying here; the "great war," as the Americans, living under greater conditions only, say—and every calculation was upset. The writer wonders whether the Amerian mill man can have a bare idea what this war meant to the non-combatant over here in the beginning, the going on, and the bitter end. For every nail, every board, and every bag of cement, for flour and lard for

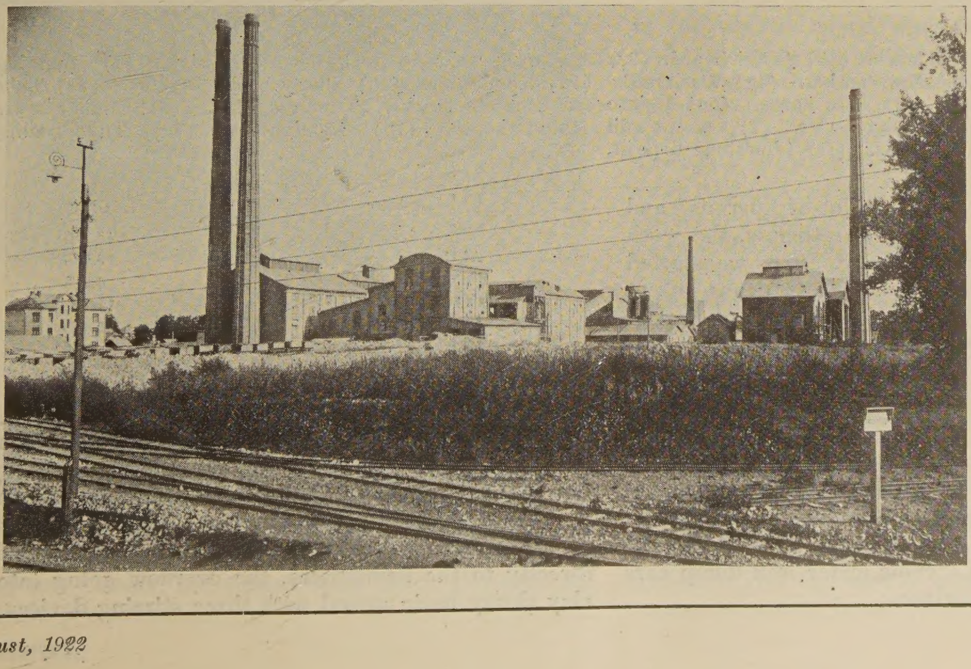


Fig. 1 — Fabrica de Ciment din Turda—Plant Seen from Raw Mill Side — (Left) Overseer's House

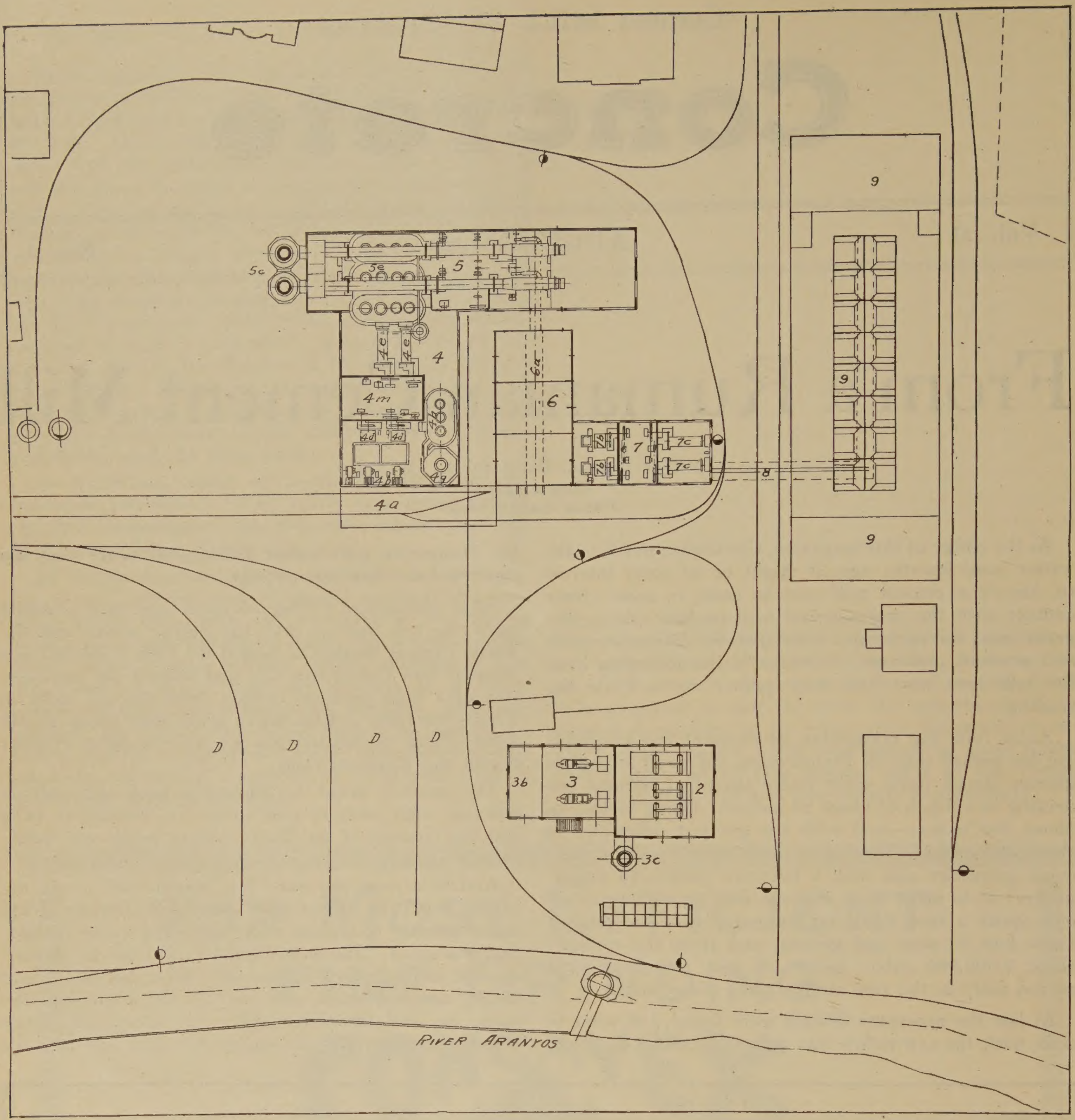


Fig. 2—Plan of the Works

(2) Boiler house. (3) Power house. (3b) Switch board. (3c) Reinforced concrete stack, 60 meters high. (4a) Dumping bridge for limestone. (4b) Jaw crusher. (4g) Wash mill. (4d) Kominuter. (4h) Slurry basin for clay. (4e) Tube mills. (4m) Motor house. (5) Kiln house. (5c) Reinforced concrete stacks, 70 meters high. (6) Clinker store house. (6a) Clinker transporting device. (7) Cement mill motor house. (7b) Kominuters. (7c) Tube mills. (8) Steel belt. (9) Cement bins. (D) Limestone deposit.

iron and belts you had to ask for a lot of "permis" and wait for as many months. But, nevertheless, the work went doggedly on, and in February, 1916, we started a modern wet, natural gas plant for 60,000 tons output a year, designed and equipped by the renowned firm of F. L. Smidth Co., Copenhagen, and designed and equipped to make a special high class portland cement.

Raw Materails

The pure, hard limestone is bought from a separate company and brought to the works about 11 kilometers on rail in 5-ton dumping cars. The clay is quarried on the works' own premises and brought about 1½ kilometers to the washmill in 1 cubic meter iron dump cars on rail. Below are the analyses:

	Limestone	Clay
SiO_2	: 1.2%	45.2%
Al_2O_3	: } 0.7%	16.9%
Fe_2O_3	:	6.2%
CaO	: 54.5%	11.1%
MgO	: trace	2.7%
Loss of Ign	: 43.5%	15.8%

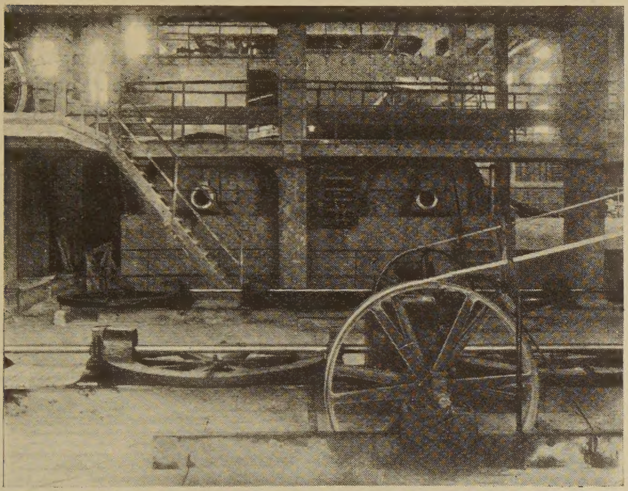
The plan of the works will be seen on Fig. 2. The limestone is taken on an endless steel wire transporting device on a slope to the three jaw-crushers—70 by 50 cm., the crushed stone going in elevators to reinforced concrete bins over the kominuters. A Smidth No. 0 washmill takes care of the clay, the clay slurry being pumped directly to the kominuters, the overflow going into the clay slurry basin armed with three stirring devices.

The two Smidth No. 50 kominuters, with 5,000 kg. steel balls each, grind limestone and clay wet in the right proportions, the stream of limestone being regulated on revolving measuring tables. The clay slurry goes over a rather ingenious, nicely regulated measuring device, and the resulting coarse slurry is taken in elevators to two Trix No. 10.

The "Trix" is a fast revolving, sieving device built on the centrifugal system. It sends the finely ground part of the mix through a 1.5 mm. sieve to the tube mills, the coarse particles flowing continually back to the kominuters.

For finishing, two Smidth Dana tube mills, No. 20, with Cylpebs, are installed. According to the plan of making a high class cement, the grinding is carried to a fineness of 7% to 8% on the 180 mesh and about 0.4% on the 80 mesh, assuring a complete mix, a good uniform burning and a completely sound clinker.

One small correcting basin and three slurry basins (Fig. 3), each about 300 cubic meters capacity, and with four stirring devices, store the mix (with 39% water), which is forced from here through three plunger pumps to the rotary kilns.



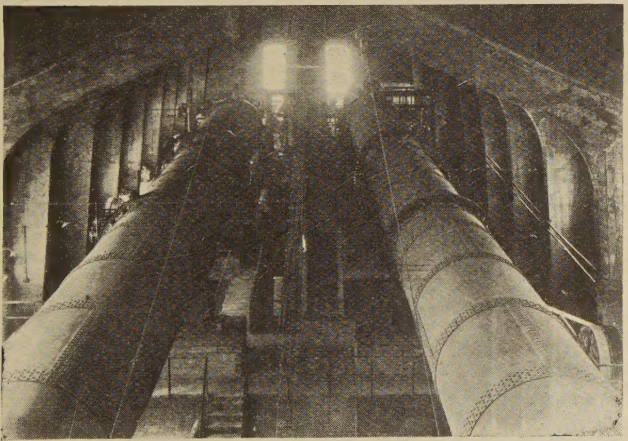


Fig. 3—Raw Mill—Tube Mills and Slurry Basins

Fig. 4—Kiln House and Kilns

These are built with enlarged sintering zone (Fig. 4) 50 by 2.5 by 2.7 meters, fired with natural gas through special ingenious burners and combined with short double coolers placed under the kilns. The cooling is done with compressed air, the hot air being forced into the kilns for combustion, cooling the kilnheads on the way and saving fuel. The clinker leaves the coolers at about 60° Celcius, the output being about 110 tons per 24 hours per kiln.

With every second bucket of an endless, automatic bucket chain conveyor of special design, the cooled clinker goes to the store house with a capacity of about 6,000 tons (Fig. 5). From a tunnel under the storehouse, the other buckets of the same conveyor can be fed automatically with the stored clinker, taking it to a rubber belt leading to the cement mill. As for storing, it proved here to be unnecessary as the clinker straight from the kilns gives a perfectly sound cement.

In the cement mill two Smidth No. 50 kominuters with Fasta sieve and two Smidth No. 20 tube mills with Cylpebs do the grinding. The output is about 300 tons in 24 hours to a fineness of 3% to 4% on No. 180 and trace on No. 80.

The finished cement goes from the tube mills over a coarse sieve to take away eventually splinters of pebbles, then over two automatic recording scales and finally on a steel belt conveyor, which takes the cement to 12 bins with a capacity of about 8,000 tons.

The writers should like here to plead for this transporting device, being to his experience and best information the ideal belt for hot cement and a lot of other materials. The steel belt here is about 0.8 by 400 mm., 25 meters long, and takes the 100° hot cement to the bins on a slope of about 10°. The ends of the belt are simply riveted together cold on the erecting place. Such a belt is light, comparatively cheap, takes very little power, and once properly erected wants but little care. It stands continual hard service for at least three or four years.

In countries as here, where the mill hands at times are rather handy, it has one further great advantage. From leather and rubber belts may be made the best of shoework, while the steel belt is of no use whatever once pocketed in small pieces, and being made of first-class steel, it is rather hard work, even for a man with a will, to put his pocket knife in it.

The 12 bins—like all the other buildings—are of reinforced concrete. Each bin has on the floor an arrangement of plain 2-in. gas pipes protruding through the outside wall of the bin, to which the pneumatic, automatic packing and weighing machines—the Smidth Exilor—are being connected. With trained hands they pack and weigh about 200 bags—about 10 tons per hour each. Special designed exilors handle the normal barrels.

The exilor works as follows: The bag is fastened on the one end of a balance in one of the two chambers. The chamber is shut airtight, a handle switches it on to the vacuum pump pipe line, and the cement flows under the pressure of the atmosphere into the bag until it is filled to the weight hanging on the other end of the balance, outside the chamber. Then the stream of cement is automatically shut off, the outside air comes in through a little valve, the door opens, the dust is taken away through a little electrical fan mounted on each exilor, and the workman takes the accurately filled bag away without being hampered by dust.

For power generating the plant has 3 natural gas fired Garbe boilers, with 270 square meters heating surface each, steam pressure 14 atmospheres and overheat about 325° (Fig. 6). The steam goes to two turbogenerators, 3,000 r. p. m., 2,000 kw. each, producing 3,000 volt 3-phase alternate current (Fig. 7). One generator is sufficient for the plant and the town electricity, the other standing in reserve.

As is to be seen on Fig. 2, every great mill and machine has its separate 3,000 volt motor, so doing away with the nasty long shafts and belts. The plant is designed to give the motors separate rooms, assembling a number of motors in one room if possible, to simplify the

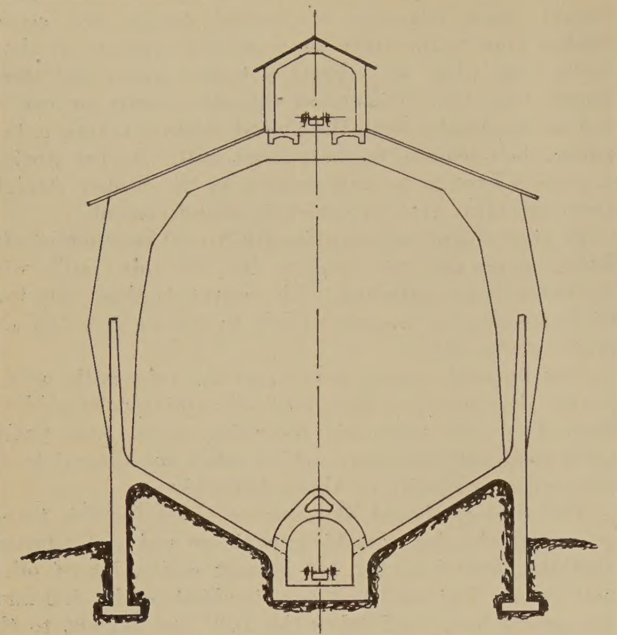


FIG. 5—CROSS SECTION OF CLINKER STORAGE IN REINFORCED CONCRETE

waiting and protect the motors from dust and humidity. For small motors, and lighting, the 3,000 volt current is transformed to 220 or 115 volt.

So far the dry facts. The resulting cement has from the first barrel stood the competition by virtue of its qualities. Here are some average data:

Fineness: 4% on No. 180.
Setting time: 2 h. 50; 5 h. 50.
Strength: 1:3 mix, normal sand.

	2 day	7 day	28 day	3 mo.	6 mo.	1 year	3 yr.
Pull:	28 kg.	37	42	47	52	54	55
Comp:	220 kg.	500	620	660	700	750	800

The figures give the strength in kilogram per square centimeter.

As far as our experience goes there has been no disadvantage whatever noticed in practical use of this extremely fine cement for the past six years. Therefore, the high initial strength is of very great advantage, especially to the reinforced concrete and the concrete products man, and although the consumer here is very slow to look out for and absolutely unwilling to pay our overprice for extra quality, the T. C. cement has as yet the best market.

FUEL

Coming from the wells with a pressure of about 22 atmospheres, the gas arrives in the works with 8 to 10 atmospheres, and here the pressure is reduced to about 0.5 atmospheres for the internal conduit. The burner pressure varies from 150 at the kilns to about 200 at the boilers—analysis:

CH_4: 99%; H_2: 0.2%; O: 0.1%; CO: 0.7%.

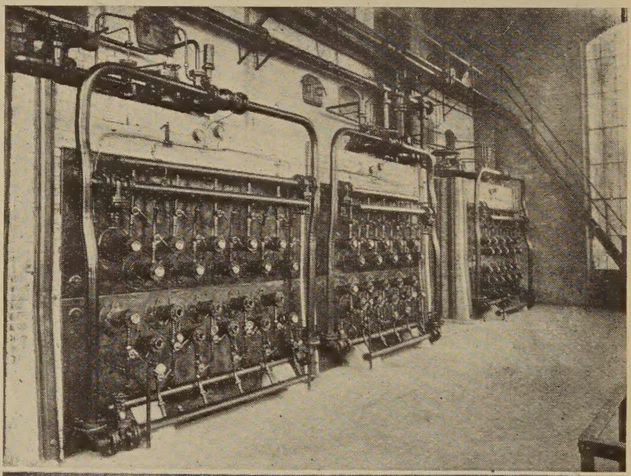
Caloric value, about 8,000 calories per cubic meter.

On starting the plant the company made a contract with the Hungarian Government for the needed quantities of gas fixing the price per cubic meter very low (about self cost) and therefore taking over the obligation to pay for the contracted 21 million cubic meters a year whether the cement plant was able to use this quantity or not. Then came the great "Smash up" in 1918 and the Rumanian government took over the actives and the passives of Transilvania and the natural gas wells as well.

By the way it is rather curious to go to bed in Hungaria one fine night and awake in the same bed the next morning in Rumania with quite another language, other authorities and so on. But back to the natural gas.

The natural gas politics of the two consecutive governments are quite different. The Hungarian government went in for selling the gas at the lowest price possible taking the profit in the creating of strong home industries, the Rumanian government for making the selling of the gas itself—as a monopoly—a profitable business. It is to be questioned whose politics are the wiser and more farsighted—each has its advantages and faults—but for the man at the plant, who believes in his contract, and a fine morning sees his gasbill reactively multiplied by 40 or 80 or 160, it is at all events rather difficult to calculate. And of course paying for the 21 millions cubic meters, which did not count very gravely as long as the price was low, could ruin even a rather sound company when the gas bill had to be paid at full or over calorical coal value, although the plant was not able to work to its full capacity because of war and revolution and peace. As it was, the government, after some time, conceived the danger in the abnormal high gas price for the home industries, and we are now paying for the natural gas at calorical coal prices.

Of course the writer is otherwise a very strong advocate for the natural gas as fuel, though on his experience he does not believe in the extraordinary *caloric* economy of the gas in relation to other fuels, especially to oil. The data given on this question some time ago in this magazine seem to verify this opinion.



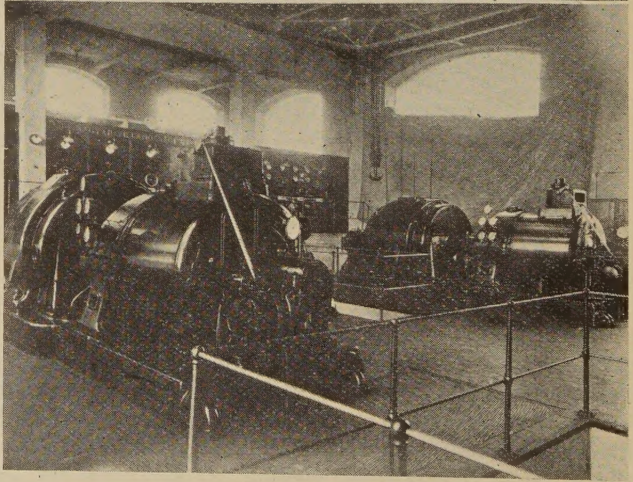


FIG. 6—BOILER HOUSE—ONLY THE BURNERS WITH THE LID OFF ARE BURNING—PLANT IN FULL SPEED

FIG. 7—POWER PLANT AND SWITCH BOARD

Labor:

On starting the plant in 1916 of course we could not have specialists or trained hands from other cement works, the workmen then being rather scarce and most of them under the colors. We had to take perfectly raw and untrained material and train them ourselves. In one of the accompanying illustrations (see Mill Section Cover) the reader will see some types of this raw material—four Rumanian mauntain peasants coming in to buy cement at the works—and may have some small idea of the difficulties. It is true that in the first years of the war we sometimes happened to get some nice people, but as the time went on the government left us but a rather weak crew, old men, boys, women, children and prisoners of war. As for the last the writer from his experience, prefers the Russians as steady and nice workmen, although he has had bad Russians and good Itaians under his hands too.

The war of course had an almighty influence on the labor question as on the moral qualities of the victorious and especially the conquered people. The germs of red socialism, which had been hardly known here before and during the war, swelled rapidly on in the years after the November, 1918, revolution, and the propinquity of the great and dangerous Russia helped to keep the agitation in flow.

To the man on the work, being in daily close contact with some hundred workmen, it was perfectly clear, that we were driving toward a catastrophe.

When on the occasion of a small strike in 1920 the workmen from the neighboring works are coming into your yard and asking you not very politely—to doff your cap, and in the meanwhile they are singing you a song—not of "The Old Kentucky Home" but of "The Three Internationale," and when a hand in the packing department fills a 50 kg. bag of cement per hour, there is surely "something rotten in the state of Denmark." By the way the cap mentioned was not doffed, but the general situation was rather intolerable in the second half of the year of 1920.

The following table will show the increasing number of hands in our works, with rather constant, or in the time mentioned, slightly decreasing output up to the general strike October, 1920.

	Average
1917	169
1918	243
1919	280
1920—	
February	280
May	362
August	495
November	508
1921	380
1922	380

In 1921 and 1922 the output was increased.

The system on which the workmen were trained from their organizations up to the great strike, was the system of "Americanizing" that is: working only at the slowest possible pace. By the way the writer should say this term must be rather difficult to understand to Amercians or people who know them and the pace in which work and workmen are "kept going" in the United States of America. The writer has tried to find out why "Americanizing" and idling are synonymous here, and his theory is, that the Hungarians and Rumanians coming home from the United States with the pocket more or less full of—particularly now—good dollars, were and are rather apt to "take it easy."

Well, in October, 1920, came the climax, the general strike, on a clear visible souviet base. Alone in our small city 50 good men were to swing in the first night, and all higher official and private positions were distributed among the leaders. It must however, be said, much to the credit of the Rumanian government, that it clearly saw the danger and with a strong hand promptly acted, or now there would have been a little Russia here, that means the worst possible state for all sane men.

The conditions for the time being between the social democratic organizations and the companies are indeed, as all over the world, that of an armed peace, but yet not at all bad, the companies' understanding of the new times and the social needs having increased too in the last years.

In most companies the "8 hour day" and the "collective contract" are accepted as a base—the last in common valid for a year as to labor conditions and with a sliding scale for the pay. Every three months a mixed commission of managers and workmen fixes the prices for a certain fixed amount of victuals, clothing and so on and for every 5% increase or decrease in dearness of life (cost of living) the pay is raised or lowered 3%, thus avoiding greater "bumps" on both sides. So far this system works pretty well here.

Besides the Rumanian government passed the "strike bill" which tries to regulate the labor conflict on the base of government arbitration, and imposes a strict verdict against every strike in vital industries.

How the cost of living and the pay have altered in this part of the world from June, 1914 as base to December, 1921 is shown in the following table, the figures giving *how many times* cost of living and pay increased in said time:

	Pay	Living Cost
Jugo-Slavia	22	21
Czecho-Slovakia	27	32
Rumania	37	27
Hungaria	83	167
Austria	1965	2329

As it will be seen the conditions of life for the workmen here are better than in all neighboring countries.

WAR AND AFTER-WAR PLANT CONDITIONS

Some time ago CONCRETE gave a description from a manager who on a break down of his machinery had the spare parts wired for, brought by airplane and put in place in no time. Well, of course U. S. A. *is* a fairy land. At a time where the common conditions had bettered considerably, September, 1920, the writer ordered some small but rather important spare parts from Czecho-Slovakia, and happened—by good luck—to get them safe and sound in May, 1922. Lnder these conditions the American system of going ahead full speed and on the wear out or break down of the machinery have the spare parts of a new machine ready in no time, of course can't be used, and we have had to work our machinery with the greatest care and economy, at the least trace of a loose nut or extraordinary wear im-

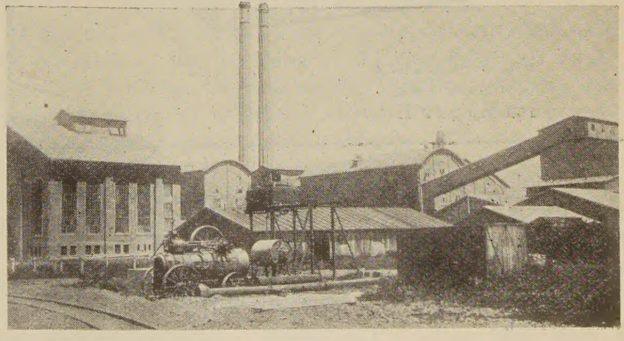


FIG. 8—PLANT SEEN FROM CEMENT MILL SIDE—(LEFT) POWER HOUSE—(RIGHT) CEMENT BINS

In the foreground are the remains of a military laundry, erected in war time on the works premises and pillaged during the revolution in 1918.

mediately repairing, and to study our machinery very closely to be able to say—or divine—where the next spare part must be put in in about 18 months.

Yet the Smidth machinery under these most difficult conditions has proved to be first class, as we, during the 6½ years run haven't had one serious break down.

As for ball mill lining the writer believes it to be near the record, that the four No. 50 Kominuters in our plant, the two grinding hard limestone and clay wet, the two rotary kiln clinker, all of them to a fineness of all through a No. 20 mesh, are running yet with their first lining.

The two wet kominuters will probably have to be relined at the end of this year, the lining of the two cement kominuters are believed by the writer, on base of the last inspection, to be good for at least 2 years more. To better judge the wear it must be mentioned that the plant during the 6½ years worked to an average of about 3/5 of its full capacity.

Besides the smaller difficulties of every possible sort we had moreover two questions to solve. Danish flint pebbles for the tube mills were not to be had, or rather we could not get them shipped except at an impossible price, and refractory bricks for the sintering zone of the kilns were just as difficult to get hold of.

We studied the first question from the geological point of view as to the possiblity of finding pebbles inside the frontiers but without success. Then we took up the question of replacing the pebbles with another natural stone and succeeded in finding such a stone, which cut to the form of small cubes served and serves us rather well. It is yet interesting to note, that as we found no difference in the cement mill wear between pebbles and the new stone, the flint pebbles stands the *wet* grinding more than two times better than the other stone.

As compensation for refractory bricks we took to the well known clinker concrete, but of course we had to look out for the study of this material as well, as we were forced to use it and could not get other bricks.

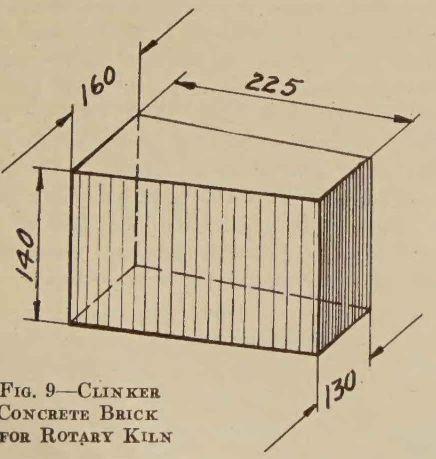


Fig. 9—Clinker Concrete Brick for Rotary Kiln

The clinker concrete bricks, as we use them here, are generally said to be rather inferior to good refractory bricks, and particularly not able to stand the cooling down of the kilns on occasional stops. As to this question, some data obtained here with clinker concrete brick lining follow:

(1) Working hours of lining: 4,058.
Stops during this time: 7 hours.
(2) Working hours of lining: 2,298.
Stops during this time: 5 hrs., 4 hrs., 9 hrs., 132 hrs., 4 hrs., 39 hrs., 22 hrs., 29 hrs.

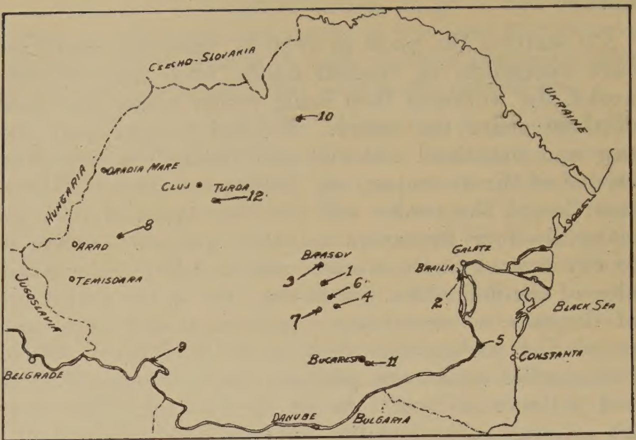


Fig. 10—Map Showing the Position of Present Plants in Great Rumania

As it will be seen, our experience proves also that—as yet—the clinker concrete brick cannot compete for standing with good refractory brick. Regarding the facts, that this lining can be cheaply made at the work itself, lasts 3 to 6 months and can be put in just as fast as refractory brick lining, the writer yet finds it a sound policy to use it.

The bricks here (Fig. 9) are made of a rather dry mix, 1:1, and rammed in in iron forms with a half-automatic ramming device, the ramming on the side of the brick. The clinkers used are taken directly from the kiln and passing a 6 mm. screen. Clinker and cement must of course be perfectly sound, the bricks well made with sharp edges. Two months' storage, with ample sprinkling, gives a good brick.

On starting this manufacture the writer was a strong advocate of a very thorough compression of the concrete, giving them 30 strokes with a 40 kg. bar from about 60 cm., and so getting a very strong concrete—1,000 kg. per sq. cm. after 28 days.

But of course, a thus highly compressed brick is rather brittle, too, while a certain porosity and lack of brittleness is claimed for the good marks of refractory bricks. On the strength of this we tried to give the bricks only 10 strokes, duly helped by the laziness of the man on this job, and mean to get a better brick now which stands the periodically shutting down of the kilns better than before. The linings mentioned above were burnt even down to about 12 m/m. (½ in.- 1 in.). As for coating, we have here found no difficulties with the bricks in relation to the refractory brick.

The writer would strongly recommend to give the question of clinker bricks a thorough investigation. A good solution of this problem may mean a good deal of saving in normal times and all saved in times of need.

Outlook

The map, shown in Fig. 10, shows the position of the present cement plants in Great Rumania:

		Daily Output (tons)
1	Azuga	80
2	Braila	780*
3	Brasov	80
4	Breaza	15
5	Cerna Voda	220
6	Comarnic	80
7	Fieni	90†
8	Gura Thont	20
9	Gura Vai	70
10	Putna	80
11	Titan	90
12	Turda	220
	Total	1,325

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*In reconstruction; destroyed during war. †In construction.

This is about 40,000 cars of 10 tons a year. The

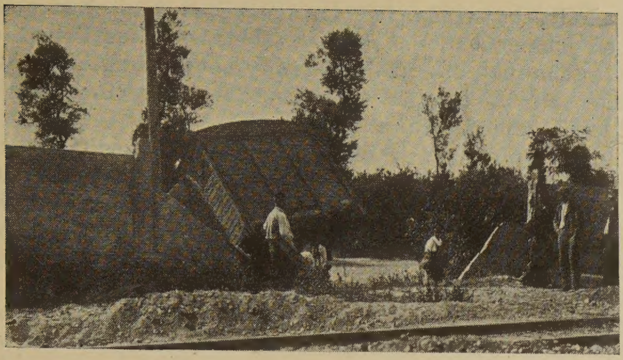

Fig. 11—The Results of a Flying Switch

consumption in 1921 amounted only to about 15,000 cars, mainly due to fuel difficulties and the bad state of the railways.

As the railway conditions have been bettered rather materially during this year, and the land is full of natural riches of every sort, only awaiting the industrial development, and with much work in repairing, the war damages to be done, it is to be hoped that for the years coming the cement industry here will be able to work full speed and to its full capacity. As it is, this land aches—as all of the European states, under the different results of the great war. It should with its riches be one of the first to come to a normal and sound life on regaining the credit of the world's bankers.

Quality Control in Cement Manufacture[1]

By Richard K. Meade
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Contrary to the general belief, the question of the quality of cement is more often a mechanical than a chemical problem—or rather perhaps one of the relation of the mechanics of the process to the chemical composition of the product. The connection between the chemical composition of cement and its physical properties is now so well understood that there are few instances where the poor quality of the cement is due to a lack of knowledge of what the chemical composition of this should be. Generally speaking, poor quality is due to circumstances which interfere with the attainment of the ideal composition by the chemist. In speaking of composition in this paper, the term is not limited to the mere analysis of the cement, but includes the proper combination of the elements to form the so-called cement clinker.

The problem of manufacturing good clinker in laboratory quantities is extremely simple. It is merely necessary to grind finely a properly proportioned mixture of argillaceous and calcareous substances, and then to ignite the mixture to the point of incipient vitrification for a sufficient time to allow proper chemical combination of the elements composing the mix. All the details of the process are well understood by cement chemists—the proper relation to be had between the argillaceous and calcareous elements, the fineness necessary to secure intimate contact, and the degree of burning to promote combination are all matters of common knowledge in the industry. When it comes to handling large quantities of natural materials and to manufacturing cement economically, however, the problem is vastly complicated. To begin with the raw materials, these generally vary considerably in chemical composition in different parts of the deposit, and the method of accurately sampling and proportioning these materials is one of the most troublesome problems with which the cement manufacturer has to contend. The question of the degree of grinding is generally limited by the mechanical equipment provided, and is always influenced by the question of economy. The problem of burning is much simpler than the other two, and is usually merely one of securing experienced and conscientious kiln attendants.

These three primary operations of cement manufacture bear a general relation to each other. Some years ago I called attention to the fact that, assuming the chemical composition to be correct, there is a very definite relation between the fineness of the materials, the temperature of burning and the time at which the materials are subjected to this temperature. I can possibly best illustrate this relation by means of a mathematical formula, thus

$$F \times D \times T = C$$

In which F represents the fineness, D the temperature, T the time, and C clinker (a constant quantity). It will be seen that if C is a fixed quantity the others can vary among themselves and still equal C. Thus with a coarsely ground mixture the time or temperature of burning one or possibly both, must be increased to secure proper combination. Similarly if the time in the kiln is short, this must be made up for by higher temperature or finer grinding.

If the fact that the composition of the mixture of argillaceous and calcareous substance can vary is considered, another variable is added to the equation. It is, of course, well known that it is much easier to burn low lime cement than high lime cement, in which case coarser grinding satisfies. In actual practice, the details of cement manufacture, therefore, are a general compromise to suit local conditions between chemical composition, fineness of grinding and degree of burning.

I am not going to take up any time today discussing the question of fine grinding of the raw materials or the degree of burning, beyond saying that fine grinding and harder burning as indicated above will tend to correct faulty composition in some instances. The importance of fine grinding of the raw materials and of proper burning are, of course, better understood, and when these are the cause of poor quality the remedy is evident.

My own experience indicates that the problem of making cement of uniform high quality is largely one of *absolute* control of the chemical composition of the mixture fed to the kilns. Occasionally I have met with a plant where the raw grinding or burning equipment was insufficient, but for the most part the failure to control the chemical composition of the mix has been responsible for the irregular quality of the product.

Chemical analysis of the cement does not always show the trouble, particularly when this analysis is confined to a sample representing a large quantity of cement, such as a bin of several thousand barrels or a day's run, because such a bin of cement may be the average of several hours of very high limed and consequently unsound cement mixed with several hours of low limed cement; the average of the two being often near the desired chemical composition, but the physical properties of the resulting cement pertaining something of the undesirable characteristics of both the high limed and low limed clinker.

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[1] Presented at meeting of the Portland Cement Association, Atlantic City, June 27, 1922.

Such a result is quite apt to occur in the dry process, where chemical control is generally a matter of examination of a mixture already made rather than of two materials about to be mixed. It is, of course, well known to most cement manufacturers that the routine tests of the dry mill laboratory are post mortems rather than diagnoses. They are of no value so far as correcting the composition of the particular lot of raw material under examination is concerned, but serve as a guide to the making of succeeding lots.

By far the larger number of mills, both wet and dry, make their mix by means of what are, in the vernacular of the industry, known as *"readings."* That is, samples of the mix are drawn from the grinding mills at stated intervals of time, and in these samples the carbonate of lime is determined. If this is found to vary from the desired standard, no correction can as a rule be made in that portion of the mix which has already been prepared, and the test serves principally as a guide to the proportioning of succeeding lots, etc. When the mix is controlled by such a process, the chemist finding his mixture too high or too low in lime (as shown by the reading) decreases or increases his limestone to correct his proportions. In the dry process this often has the effect of sending his composition to the opposite extreme, with the result that while his low lime and high lime clinker will average properly, very little of it is *per se* of correct composition.

In the wet process, however, an opportunity is generally given to mix the whole lot of ground material by combining the contents of several slurry basins in one large kiln feed basin, and in this way the averaging is done before the kiln is reached, and hence the clinker is of correct composition.

At many dry process cement plants the question of chemical control is largely one of good judgment on the part of the chemist, rather than of chemical test. For example, let us cite the case where a limestone and shale plant is supplied with rock by one large steam shovel. The shale is regular, but the various strata of limestone differ much in chemical composition. Added to this variation is also the fact that 3 or 4 ft. of clay overlaying the limestone is not stripped from the latter, but is blasted down with it. Deep well drills are used, and the shots are large, each representing several months' supply of stone. All stone is sent direct from the shovel through crushers into a relatively small storage bin, and the mix is controlled entirely by "readings" taken from the tube mill discharge. Let us suppose, as frequently happens, the shovel is working in the morning on clean limestone comparatively free from stripping. At noon it encounters a limestone mixed with stripping, and by night it has worked through the stripping and is back on the clean stone. What happens to the mix is this—some time during the afternoon the sample drawn from the tube mill shows the mix to be overclayed and the chemist accordingly decreases the shale. The orders to make this change probably reach the raw mill about the time the shovel reaches clean stone again, with the result that the next sample drawn from the tube mill will show the mix over-limed, etc. At this mill, the mix would generally be wrong, but for the visual inspection and good judgment of the chemist. This condition is by no means unusual, and while probably not existing often in quite such an exaggerated form, does occur in a more or less modified form at many mills.

In my opinion, it is *everlastingly* to the credit of the American chemist that he can make cement *superior* to any in the world with the crude methods often supplied him. He may not be as "long" on theory as his English and German confreres, but for the exercise of good, hard, common sense and rare judgment he has them both, to use a slang expression, "backed off the map."

So far as quarrying methods are concerned, the steam shovel and the deep well drill are likely to stay, and it is also in most instances more economical to include the overburden in the blast rather than to strip; at the same time, it is evident that these three improvements in quarry efficiency have increased materially in most instances the difficulty of securing a uniform mix. The big blast throws down the entire vertical face of the quarry in one jumbled heap. If it served also to mix the various beds intimately, it would be of advantage; unfortunately, the opposite is generally true, and the beds remain almost as separate, but not as easily *segregated,* after the stone is blasted down as when in the position left by nature. In the case of the old method quarrying, by means of 16 to 20 ft. benches, the beds were usually blasted down in some sort of order and could be quarried uniformly. The steam shovels also confine the stone supplied the mill to that obtainable from one or two points in the quarry, while with hand loading the stone can be obtained from almost the entire area of the quarry.

If the overburden could be intimately mixed with the stone there would generally be no objection to its being blasted down with the stone. Unfortunately this result cannot often be obtained and the overburden usually lies over part of the rock only.

With these new conditions occurring in the quarry, provision must be made at the mill to take care of the irregular supply of stone and clay sent to the mill by the shovels. The influence of occasional variations in the composition of the raw materials are designed to be taken care of at most plants by storage bins of varying forms and sizes.

Usually the shale or clay supplied the mill, whether obtained by means of shovels or hand labor, is of regular composition. Sometimes with clay the moisture content needs careful supervision. A few mills use a calcareous shale in which the lime content varies over quite a range. The use of such shale always greatly complicates the problem of controlling the chemical composition of the mix by introducing two variables instead of one.

The employment of a large stone storage divided into two or more bins seems to be the most feasible method of securing a uniform raw material. In many instances, however, such stone houses are poorly designed. If we place rock continuously on the middle of a pile and draw at the same time below from the center of this, we will obtain pretty much the same stone that is being delivered to the pile and very little if any mixing will occur. Even where the discharge is not directly under the point of filling, this flow of material between the two points occurs. In designing a stone house, therefore, this should be divided into at least two bins, but I do not think anything is gained by numerous small tanks or bins.

Another action which should be kept in mind is the so-called segregation of materials in the bins. If a mixture of coarsely crushed limestone is fed from an overhead source into the center of a pile it will be found that the coarse material will roll to the outside of the pile, while the fine material will lie where it falls. If the pile is tapped from the center the first material drawn is almost entirely the fines, while the coarse material is the last to be obtained. As the fine material usually contains the stripping and is always lower in lime than the coarse material, it will be seen that the composition of the material obtained when the pile is first tapped will be much lower in lime than that of the last portion obtained.

Many plants employ what are termed blending bins, consisting of large tanks in which the coarsely crushed material is stored. My observation has been that these bins, instead of blending, actually segregate, for the reason given above.

It has always seemed to me that the traveling crane and grab bucket afford excellent methods of storing limestone. With this outfit the material as crushed can be uniformly distributed over a large pile. There is no segregation of fines and coarse, and the reclaiming can also be distributed over a large area. It is a simple matter for the chemist to work out for the crane operator a cycle of filling and emptying such a storage which will give uniform material and leave nothing to the judgment of the operator.

Another excellent storage is one consisting of several long rectangular and fairly deep bins filled by means of an overhead belt conveyor. This latter is in turn equipped with a traveling tripper. This tripper is so designed as to move at a regular rate slowly back and forth over the entire length of the bin and spread the material in uniform layers over this. If the bin is relatively narrow and the openings below are alternately to each side of the center line, the segregation between coarse and fine material is negligible where the stone is drawn from several openings.

For those who prefer a pan conveyor or bucket carrier to the belt conveyor, the buckets can be arranged to deposit the material at a number of points in the bin. No doubt, other methods of securing the same result are available. Where a silo storage is employed, if the number of bins is sufficient to permit it, better results will be obtained by filling or emptying a number of these at the same time by some such method as I have suggested, rather than to fill and empty in rotation.

So much for the form of storage. Another fact which should be borne in mind is that the finer the rock is crushed, the better mixture will be obtained and the less segregation will occur in the bins. For this reason, I would suggest crushing the materials as far as practicable before storage.

For determining the proportions of the two materials where the mixing is done directly after the large stone house, two methods are generally employed. One is to obtain a sample of the contents of the bins of clay and limestone and mix the two as indicated by the analysis of this sample. The other is what is generally designated as the "reading" method and consists in mixing the two materials according to the results obtained from a determination of the carbonate of lime in the mix after this has been ground in the mill. In spite of the fact that it is apparently much the less scientific of the two methods, the second one will usually give better results. This is because of the difficulty of properly sampling material in large pieces mixed with fines and intermediates.

The only method of sampling such material which will give accurate results will be some system of crushing and quartering in several steps such as is used for ore sampling, and this would involve an expensive sampling plant. As an illustration of such a plant, let us suppose that the material came from the crusher in a pan conveyor. Arrangement could be made to trip every tenth bucket into a small crusher, which would crush to, say, 1 in. and under. The discharge from this crusher would then be sampled and the sample crushed to, say, 1/4 in. This 1/4 in. material in turn would be sampled and the sample crushed to 10 mesh. The fine material could then be sampled and this final sample ground to the necessary fineness for analysis. It will be seen that such an arrangement would involve handling quite a lot of material.

In a cement plant using 1,000 tons of stone per day the first sample would amount to 100 tons to be crushed to 1 in., the second to 10 tons, to be crushed to 1/4 in., the third to 1 ton to be ground to 10 mesh and the fourth to 200 lbs. to be ground to laboratory fineness. It is doubtful if accurate results could be obtained with much greater fractions. It will readily be seen that the equipment necessary for such quantities is beyond that now available in cement mill laboratories.

The methods necessary for securing uniform rock at the mill are the same, whether the wet or dry process is employed, and to my mind the desirability of such a supply of rock of uniform composition is as great in the one process as the other. In the older wet process plants, provision was made for adding clay or marl as desired, to the ground slurry before this was pumped to the kiln supply basins. Today, however, when necessary to correct the composition of the slurry, the general practice is to mix two or more tanks to give the desired results, so that as far as the mix goes the two processes approach each other much more nearly than they did when the raw materials of the wet process were marl and clay. In the matter of chemical control, there are unquestionably much better facilities provided at most wet process plants than there are in the general run of dry process mills. When difficulties of controlling the mix do occur in wet process plants, this is usually due to too few or too small slurry basins, and kiln feed tanks, or to improper or insufficient agitation.

I have always felt that the methods employed to control the mix at most dry process plants were insufficient and that a system of correcting tanks planned after those of wet process plants could be employed to advantage. If the grinding is done in two stages, such as with ball and tube mills, I would suggest the use of two sets of tanks or bins. One set of at least four, and better, six or eight tanks to be placed after the preliminary mills (ball mills) and one set of four or more after the secondary mills (tube mills). The tanks in the first set should be sufficiently large to take care of at least four hours' run of the mill. The system should be provided with an automatic sampler so that the contents of each tank can be sampled as ground. Where ample rock storage had been provided to give fairly uniform rock, the four tanks could then be used in this manner. One tank would be filling, the second tank would be under test, and the third and fourth tanks would be used straight, or mixed if nessary to give the proper composition. When analysis proved a tank to be of incorrect composition, it would be necessary to so proportion the next tank that the two could be mixed so as to give a mixture of correct composition. The second set of tanks would receive the fully ground material and these should also be provided with automatic samplers. They serve as a further means of correcting the mix when necessary by lending the contents of two or more tanks as the pulverized material is sent to the kiln. The mixing here is not as thorough as would occur when the two materials were ground, but still fairly good mixing would occur when screw conveyors were used to carry the mix from the tanks and conidserable mixing would also be effected in the upper part of the kiln before the material began to form into balls.

At some plants it would no doubt be found most convenient to use such a series of tanks for mixing. That is, to grind the materials separately to 10 to 20 mesh before the mixing is done. In this case certain tanks would be set aside for limestone and certain tanks for clay, and both materials would be sampled automatically and mixed according to the analysis of these samples. It is comparatively easy to secure an accurate sample of 10 or 20 mesh material, while it is extremely difficult to obtain anything which will properly represent material crushed only to 1 in. So that this system of sampling, analyzing and mixing will do with 10-mesh material, but will not give satisfaction with 1-in. material. The statement that the finer the material, the easier it is to sample accurately will hold good for all materials.

No doubt various modifications of this system would be devised to suit local conditions. For instance, at certain plants it might be found best to mix partly by analysis and then to do the correcting by adding to the contents of the tanks as drawn a small amount of clay or limestone ground to 10-mesh. I am not trying to outline a plan to be followed by all plants, but merely to indicate lines along which such a system may be worked out. The cost of operating such a system would be low, and the initial investment small. I believe the saving in other lines aside from quality would pay for the installation and upkeep of the system. Such saving would include fuel required to burn over-limed mix, power to grind under-limed clinker, labor due to greater kiln outputs, greater life of kiln linings, etc.

In the earlier paragraphs of this paper, I have shown how the various steps in the process of cement manufacture bear one on the other. From this it will be evident that if there are shortcomings in one step, these must be made up for in the next. If the composition is irrgular, the grinding of the raw materials must be carried to the degree of fineness necessary to give sound cement from the high lime mixture as well as from the low lime. Every chemist knows that where the lime is high, much finer raw grinding is required than where it is low or even normal. In order to make sure of sound cement, the chemist must therefore grind finer where occasional runs of high lime material are encountered, than where the mixture is constant. The proper fineness of the raw materials are therefore influenced to some extent by their composition.

The proper burning of cement is largely one of feeding the material and fuel to the kiln at a regulate rate. If the composition of the mixture is constant, it is evident that if the material is fed to the kiln at a regular rate and the kiln is kept at a definite temperature and revolved at a constant speed, the resulting clinker will be uniformly burned. The rouble with the burning is, first, that the composition changes, requiring a higher temperature or a longer time in the kiln, and, secondly, that the rate at which both raw material and coal are fed to the kiln is subject to violent and sudden fluctuations, or in other words, both coal and raw material "flood." I believe that where trouble with the burning results much of this can be eliminated by designing proper feeding arrangements for both raw material and fuel. The irregularities due to change of composition come gradually and can be kept up with, while the feeding of the raw material is usually sudden and the extra load of material occasioned thereby is hard to catch and properly burn. The arrangements for feeding slurry to the kiln, where this is done by positive means such as buckets and scoops, are excellent and something of the same sort is desirable in the dry process.

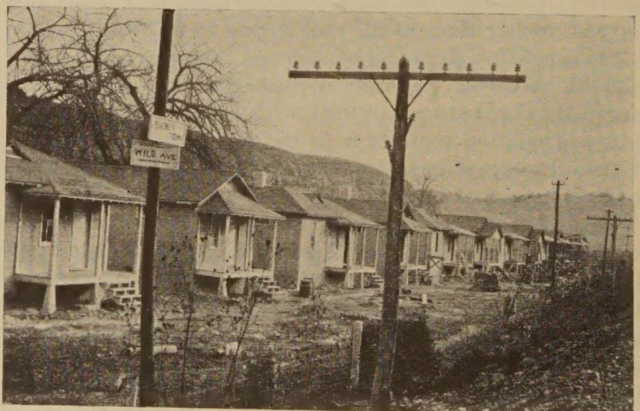
The qualities most desirable in cement are soundness, strength and uniformity in the rate of setting and hardening. All are dependent to a marked degree on chemical composition, the fineness of the raw materials, and the burning. These three steps are therefore the ones which must be under perfect control if quality cement is to be produced. I regard the chemical composition as the keystone of the arch. Unfortunately, it is the step least under control. While there are many plants where unsound or quick setting cement is a rarity, even here there might be an appreiable improvement in quality by a closer regulation of chemical composition. Most cement chemists are playing safe, as it were, rather than attempting to attain any ideals. Perfect control of the composition would enable them to make cements much higher in lime than they do at present, with the result that their clinker would be easier ground and the resulting cement stronger and more uniform in setting and hardening qualities.

Colorado Company Builds Houses for Employees

By E. J. Strock

The accompanying picture illustrates some of the houses being built by the Colorado Portland Cement Co. for its colored employees. Twelve of these houses are being completed, the construction being of expanded metal lath, both inside and out, on wooden studs. Half of the houses are of two rooms each, and the other half are of three rooms each. They are all pebble-dash, finished on the outside. The foundation walls extend 3 ft. above the ground and are well ventilated to keep the floor joists from rotting.

These houses are neat as well as convenient and warm, They are small, as the employees for whom they were planned do not care for large rooms or many of them.



It will be noted by the sign on the post that the community comprising these houses is called "Reubentown." This was a joke on the general manager, while "Wild Avenue" is on the company's chief clerk, an old-timer.

The company is also building seven five-room cottages and ten four-room cottages that will be roomy and very pretty; in fact, it is believed that they will be better than anything of their nature in their locality.

One of the company's future lime quarries may be seen directly in the rear of the cottages shown in the illustration.

The Passing of Picturesque Lime Kilns

In the onward march of the lime industry many picturesque stone kilns, like the one shown in the accompanying illustration, are crumbling into ruin in southeastern Pennsylvania. They have been replaced by modern plants built of steel and concrete, in which lime of a superior quality is made rapidly and with greater economy.

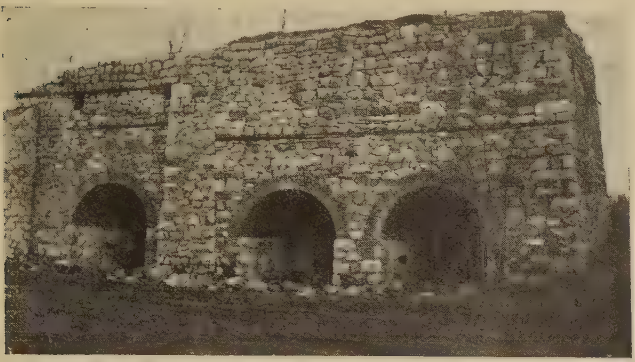


Fig. 1—Picturesque Old Stone Lime Kiln in Southeastern Pennsylvania

The old-time kiln shown, constructed of stone and brick, is on the property of the Palmer Lime and Cement Co. Although it is one of the largest of its kind in the limestone belt, its output is very small, and in proportion to the new type of kiln it is almost negligible. Only a few tons of lime were made at each burning, and consequently plants like this were able to supply the agricultural and building needs of only a very limited area. This particular kiln has been idle for some time, but is being reconstructed and will be somewhat increased in capacity and again put in operation. It has been replaced by a steel kiln and hydrating plant, and where two or three men were needed to keep the stone kiln in operation, many quarrymen are now kept busy day and night feeding the modern lime plant.

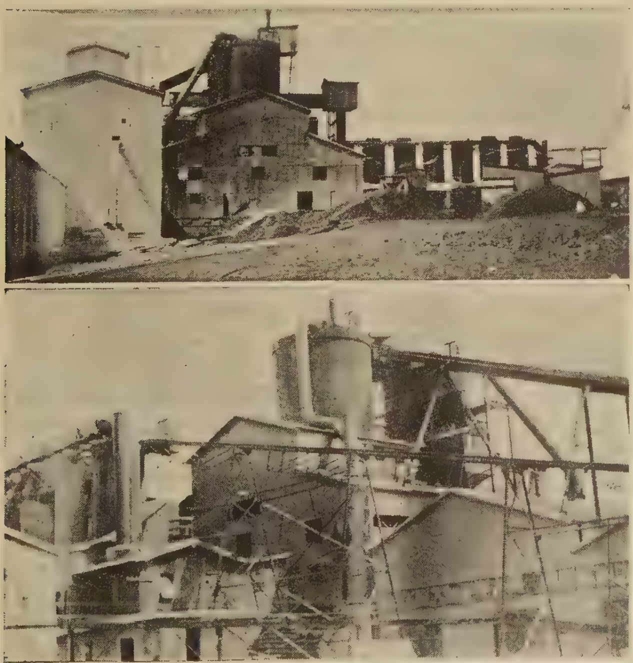


Fig. 2—Modern Lime Plant That Has Largely Replaced the Old Stone Kilns

The modern plant shown in Fig. 2 is also owned by the Palmer Lime and Cement Co., and is located at York, Pa. This plant has a capacity of 480 tons of burned lime in twenty-four hours, and is considered one of the most efficient of its kind in southeastern Pennsylvania, a district where considerable lime is burned. The stone burned in these kilns averages 96% pure lime, and new quarries just opened have produced rock that is as high as 98% pure. Two of the kilns shown in the picture use producer gas as fuel, and the other kiln is fired with coal.

In addition to the burning of lime there is operated a hydrating plant and a chalk plant, where various products are made that are used in a variety of industries.

Safety Specifications for Conveyors and Conveying Machinery

The decision of the American Engineering Standards Committee to undertake the development of a safety code for conveyors and conveying machinery is of importance in the prevention of accidents, particularly in industries like the cement and lime industries, where conveyors are of general use in handling the material throughout the various stages of manufacturing.

While the installation of mechanical conveying equipment has in many instances reduced the amount of hand labor connected with handling materials, and thus reduced the number of possible accidents, a few dangers have arisen as a result of the mechanical installations, and it is to overcome these difficulties that the effort will be made to bring about cooperation between the manufacturer and user of conveying equipment.

The code will be sponsored by the American Society of Mechanical Engineers and the National Bureau of Casualty and Surety Underwriters, and other interested organizations will be called upon to lend cooperation in the preparation of the code. It is aimed to make the code a guide for the safe operation and maintenance of conveyors and conveying machinery, such as gravity, belt, chain flight bucket, apron, screw, and jigging conveyors, car hauls, aerial cable ways, overhead trolleys and pneumatic tubes.

Southern Railway Rate Justified

Reduced rates on cement in carloads from Leeds, Ala., to Virginia cities proposed by the Southern Railway, were found justified by the Interstate Commerce Commission on July 17, and suspension of the proposed rates pending investigation was ordered vacated as of August 1. The schedule filed by the Southern Railway lines involve a reduction in the carload rate from 29 cents to 21.5 cents per 100 lbs. The Lehigh Portland Cement Co., operating a mill at Fordwick, Va., protested against the reduced rates, as in marketing its product in the Southeast it competes with plants at Leeds, Rockmart, and elsewhere.

The Southern represented that originally an increase in the rate from Leeds to 29 cents was error by its publishing agent. It admits that the 21.5 cent rate is low for the movement from Leeds to the Virginia cities, and that cement rates in that territory generally should be readjusted. It has stated its intention to undertake this work, but meanwhile it aims to restore the disturbed adjustment.

Portland Cement Output in June

The statistics shown in the following table, prepared under the direction of G. F. Loughlin, of the United States Geological Survey, are based mainly on reports of producers of portland cement but in part on estimates. The estimates for June were made necessary by the lack of returns from three producers.

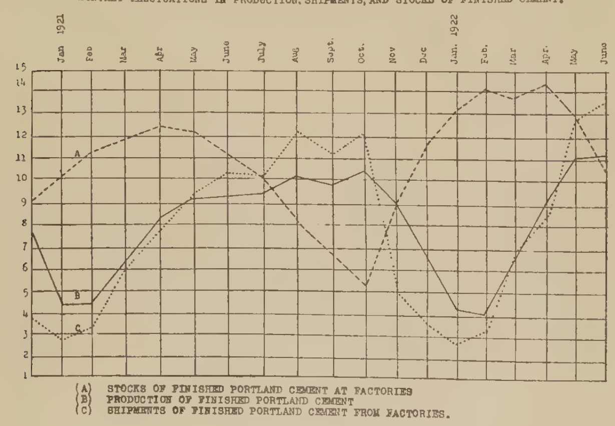
PRODUCTION, SHIPMENTS, AND STOCK OF FINISHED PORTLAND CEMENT IN JUNE, 1922, AND PRECEDING MONTHS

	Production (bbls.)		Shipments (bbls.)		Stocks at end of month (bbls.)	
	1921	1922	1921	1922	1921	1922
Jan.	4,098,000	*a*4,291,000	2,539,000	*a*2,931,000	10,300,000	*a*13,316,000
Feb.	4,379,000	4,278,000	3,331,000	3,285,000	11,400,000	*a*14,142,000
Mar.	6,763,000	6,685,000	6,221,000	7,002,000	12,000,000	*a*13,848,000
1st quar.	15,240,000	15,254,000	12,091,000	13,218,000	....	....
Apr.	8,651,000	9,243,000	7,919,000	8,592,000	12,600,000	*a*14,470,000
May	9,281,000	11,176,000	9,488,000	12,749,000	12,450,000	*a*12,893,000
June	9,296,000	11,245,000	10,577,000	13,470,000	11,150,000	10,668,000
2nd quar.	27,228,000	31,664,000	27,984,000	34,811,000	....	....
July	9,568,000	....	10,301,000	....	10,414,000	....
Aug.	10,244,000	....	12,340,000	....	8,280,000	....
Sept.	10,027,000	....	11,329,000	....	6,953,000	....
3rd quar.	29,839,000	....	33,970,000	....	....	....
Oct.	10,506,000	....	12,114,000	....	5,348,000	....
Nov.	8,921,000	....	5,195,000	....	9,091,000	....
Dec.	6,559,000	....	3,697,000	....	11,938,000	....
4th quar.	25,986,000	....	21,006,000	....	....	....
	98,293,000	....	95,051,000	....	....	....

(*a*) Revised.

The Bureau of Foreign and Domestic Commerce of the Department of Commerce, reports that the imports of hydraulic cement in May amounted to 2,521 barrels, valued at $9,117. The total imports in 1921 amounted to 122,317 barrels, valued at $388,823. The imports in May were, from Canada, 1,676 barrels; Japan, 790 barrels; other countries, 55 barrels. The imports were received in Porto Rico, 1,245 barrels; Hawaii, 790 barrels; Washington, 479 barrels; Maine and New Hampshire, 5 barrels, and San Francisco, 2 barrels.

MONTHLY FLUCTUATIONS IN PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED CEMENT.



The exports of hydraulic cement in May were 100,068 barrels, valued at $284,493; of this total 97,889 barrels, valued at $270,853, was portland cement, which was sent to Cuba, 41,370 barrels; the other West Indies, 3,246 barrels; South America, 24,389 barrels; Canada, 11,573 barrels; Mexico, 10,170 barrels; Central America, 6,555 barrels; other countries, 586 barrels. The total exports of hydraulic cement in 1921 were 1,181,014 barrels, valued at $4,276,986.

The statistics of imports and exports of hydraulic cement in June are not available.

IMPORTS AND EXPORTS OF HYDRAULIC CEMENT IN MAY, 1922, AND PRECEDING MONTHS (*a*)

Month	Imports (bbls.)		Exports (bbls.)	
	1921	1922	1921	1922
January	14,678	17,036	225,561	70,725
February	18,269	5,157	84,230	82,421
March	7,631	1,597	97,302	103,556
April	1,540	10,855	93,009	75,412
May	2,035	2,521	82,409	100,068
June	1,657	(*b*)	100,831	(*b*)
July	3,455	.....	81,091	.....
August	10,988	.....	84,538	.....
September	5,177	.....	84,668	.....
October	11,448	.....	79,871	.....
November	20,112	.....	71,214	.....
December	25,327	.....	96,290	.....
	122,317	.....	1,181,014	.....

(*a*) Compiled from records of the Bureau of Foreign and Domestic Commerce.

(*b*) Imports and exports in June are not available.

Present Specifications for Portland Cement Used by Jugo-Slav Government[1]

BY K. S. PATTON

CONSUL, BELGRADE

The following specifications for portland cement used by the Government of the kingdom of the Serbs, Croats and Slovenes have been obtained from the Ministry of Public Works:

1. Portland cement as obtained by calcining natural chalky clay or an artificial mixture of clay and chalk or limestone should be so finely divided that for each hydraulic unity of the contents there must be at least 1.7 units of lime (CaO). This cement must not contain more than 5% of magnesium oxide (MgO).

2. Cement must be very finely ground and must not contain grainy or coarse agglomerated contents; it must set slowly both in air and under water, and must retain as far as possible its original volume. A good cement, with 25-30% of water, should not begin to set before 30 minutes, requiring at least 3½ to 4 hours to set completely.

3. Supervising officials engaged in the construction of bridges are authorized to require from the contractor to make tests at his own expense as to the quality of cement, setting forth: changes in the volume during the setting, duration of setting, duration of hardening, and tensile and compression strengths. For larger concrete works these tests should be made for every 100 cubic meters of cement.

4. The quality of the cement is tested on test cakes made of 1 part of cement by weight, and 3 parts of common sand by volume, taking for 1 cubic meter of cement the weight of 1,400 kgrs. By common sand is meant the clean silica sand as obtained in sieves from 64 meshes to 144 meshes per sq. cm., and the dimensions of the sand grains should not exceed 0.3 mm. to 0.4 mm. The strength of these cakes should be: After 7 days of setting, at least 12 kgrs. per sq. cm.; after 28 days of setting the tensile strength should be at least 22 kgrs. per sq. cm., and at compression 222 kgrs. per sq. cm. Tests for tensile strength should be made on cakes having at least 5 sq. cm. in cross section. For compression tests cubes should have at least 50 sq. cm. in cross section. Test cubes should be left at least 24 hours in air and should be protected against quick drying, after which they should be submerged in water from 15-18 C.

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[1] From Department of Commerce report.

Iron and Steel, and Their Application in the Cement Industry[1]

By W. R. Shimer
Sales Metallurgist, Bethlehem Steel Co.

It was my original intention to present a paper containing definite recommendations for the more important iron and steel parts used in machinery for the manufacture of cement. Upon going into this phase of the subject in detail, I find that, due to various local conditions, a steel which is satisfactory for a certain part at Cement Plant "A," may not be suitable for the same part at Cement Plant "B." This is due to various reasons, such as difference in hardness of rock, type of machinery, condition of machinery, personnel of men operating the machinery, etc. I will, therefore, confine myself to more or less general remarks and attempt to show how to obtain steel which will best suit the purpose, and how to draw up specifications which will assure a satisfactory product.

The writer cannot claim to be familiar with the mechanical details of cement machinery, and is, therefore, not in a position to ascribe failures to faulty design, although from an examination of certain failed parts there is every indication that some of the failures can be attributed to error in design. For example, the writer had the opportunity to investigate the breakage of shafts in an electrically operated shovel. This shovel was operated in the same quarry with two steam shovels. No shafts were known to break in either of the steam shovels, while the shaft breakages in the electric shovel were quite frequent. The writer was called in on this matter after the cement plant had proven to the engineer who built the shovel that power was developed which stressed the shaft to a load of twice that for which it was originally designed. In other words, when the electric shovel was attempting to dig out the side of a hill in one scoop, and since an electric motor will withstand a 100% overload momentarily, the shafts were stressed to double the amount for which they were designed, and as this stress was a sudden one, the shafts naturally twisted off. I understand that when a steam shovel is overstressed it will stall; there are no sudden shocks, and consequently shaft failures are much less frequent in shovels of this type.

The shafts in the electric shovel could not be made larger without making very radical changes throughout the entire mechanism, and it was, therefore, necessary to use a special nickel chrome steel, heat treated, to give more than twice the elastic limit of the original shafts, and at the same time, the elongation and the contraction of area had to be fairly high to insure sufficient ductility to withstand the usual shock and vibration.

The physical properties of the failed shafts showed approximately the following:

Tensile strength	62,000
Elastic limit	32,000
Elongation, per cent	35.5
Contr. of area, per cent	61.07

The heat treated alloy steel shafts showed:

Tensile strength	112,000
Elastic limit	90,000
Elongation, per cent	22.5
Contr. of area, per cent	64.0

These physical properties more than make up for the deficiency in the size of the shaft.

It might be of interest to mention in this connection that for quick repairs, cold drawn shafting was used for shafts in this shovel, and some broke in one week's time.

While on the subject of cold drawn steel, I might mention its properties and the object in using it. It is made by pickling all the scale from the hot rolled bar, which is then pulled through a die 1/32 to 1/16 in. less in diameter than the original bar. This produces a bar of accurate size, with a smooth, bright finish. The bar is reduced cold and while cold extends in length in proportion to the amount of reduction in cross section. Low carbon steel is cold drawn without annealing, but the higher carbon and alloy steels are annealed first. The physical effect of this cold working is to raise the elastic limit, in the smaller diameters, up to approximately 90% of the ultimate tensile strength, with a corresponding decrease in ductility. Prior to cold drawing, the elastic limit of the same steel approximates 50% of the tensile strength, with considerable ductility. I would not recommend that cold drawn steel be used for important structural parts, which must withstand shock and vibration. It is an excellent steel for screw stock, bushings, sockets and parts of this nature, which must be turned out cheaply by the thousands on automatics. It is satisfactory for line shafts and other parts of like nature, which are not highly stressed. Some years ago an automobile company, in an attempt to save money on lathe work, used for a time a cold drawn alloy steel for axles. They were drawn to finished size, and all the machining that was required was to cut to length and mill the ends square. This proved to be expensive economy, as these axles failed in many of the cars after short service, and replacements were made free of charge in order to satisfy the car owners. The replacing axles were made of a special heat treated alloy steel, and they returned to the practice of turning the bars on a lathe rather than to obtain the accurate size by cold drawing.

Cold drawn steel has its field, and I do not wish to be misunderstood in my remarks concerning it. It is, however, false economy to use it for highly stressed parts, as there are so many steels which can be heat treated to stand up under severe service and which will far outlive cold drawn steel.

Many parts fail in cement machinery on account of not being heat treated, or having been improperly heat treated for the service to be performed. Many times steel of correct composition for a certain use fails in a very short time, because of improper heat treatment. When properly heat treated this same steel will give satisfactory service. As a concrete example of this, I will cite the case of an order we received some years ago for ten bars of nickel steel 4 in. in diameter. This order was received from a drop forge concern, and from the composition of the steel ordered it was inferred that the steel was to be cut up and forged into gear blanks, which were to be subsequently heat treated. This steel was, therefore, shipped to the customer in its annealed condition, having been annealed for machinability. A short time later we received a complaint, stating they had made piston rods from three of these bars and put them in drop forge hammers. One lasted 2½ hours and broke; another lasted 5½ hours, and the third lasted about 15 hours. They stated this so-called high grade nickel steel was inferior to brass or wrought iron. The remaining seven bars were returned and given a special heat treatment by quenching in oil, with subsequent annealing, and were returned to the customer and were found to be entirely saticfactory. This is one of the many examples which could be cited to show that while steel properly heat treated is satisfactory for the service required, steel of the same heat but improperly heat treated is not satisfactory. I might mention that in order to obtain the best service from alloy steels, they must be heat treated, as it is not good economy to use them otherwise. When heat treated, they are far superior to ordinary steels.

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[1] Presented at meeting of the Portland Cement Association, Atlantic City, June 27.

Proper attention is not always given to steel castings, due in part perhaps to the users feeling that because the casting was made of steel instead of iron that it had all the strength that was required, with the result that no check was made as to the analysis of the steel, or to its annealing. This applies, of course, to commercial castings. There has come to my attention quite a few failures of machines where steel castings have been used. The machines in mind at the present time are large jaw crushers.

Up to a few years ago the primary crusher was fitted with a jaw opening of about 24 in. by 36 in., but with the advent of steam shovels it became necessary to increase the size of crushers, with the result that these machines are now built with openings up to 5½ ft. by 7 ft.

In the designing of these larger size crushers, the manufacturers went to the use of steel and made a great many of the crushers in sectional design, i. e., the side frames and end frames being separate castings, machined and held together by turned bolts.

Another design of crusher consists of a "semi-steel" frame reinforced with a cast steel band, which is shrunk around the bottom of the frame and a cast steel band around the top. The design of this crusher is such that the steel bands take all of the crushing strain.

The failures of these steel crushers have been due partly to the fact that the analysis of the steel was incorrect, and partly to the fact that the castings had not been properly annealed, if annealed at all. In one of the large plants, not so long ago, there was broken in operation a crusher in which the frame was 20 ft. long and the cross section of the steel about 6 in. by 5½ ft.

The breakage of these castings showed that the steel was very coarse grained and that it had not been properly annealed, with the result that original strains were still in the castings. Had these castings been properly annealed, there is no question but that the machine would have stood up and that the breakage would not have occurred. The repairs to this particular machine will cost the operating company many thousands of dollars, as the machine will first have to be banded together to permit it to continue to operate, and later the side frames entirely replaced with new castings.

There has also been brought to my attention the failure of a crusher which was reinforced with a heavy steel band. This band was of oval shape and had a wall cross section of 5 in. by 24 in. It broke at three points almost simultaneously, and the nature of the breaks indicated brittleness. Upon investigation it was found that the casting was too high in carbon, and further that it had not been properly annealed. The microscope showed a structure of steel in the same condition as when cast, and if it had been annealed at all, it only went through the motions of this operation, as there was no indication whatever of annealing from the examination of the casting itself.

Foundries or forge plants will often, in order to fill up their shop, take on work for which they are neither trained nor equipped to handle. Sometimes, by good fortune, their product stands up in service, but in many cases like the one just cited, it did not, and caused considerable loss to the cement plant and considerable embarrassment to the crusher manufacturer, who was not directly to blame. Manufacturers of machinery should, however, investigate the foundry prior to placing orders for castings, to determine if they are competent to make such castings, and the castings should be inspected to be sure they are of the right composition and properly annealed.

The practice generally followed is to specify certain physical properties in accordance with the specifications of the American Society for Testing Materials. These tests being taken from coupons which are attached to the casting, and heat treated with the casting. Test coupons are integral with the casting. They should not be broken from the casting until it has been heat treated. If, by accident, the coupons should be broken off prior to annealing, they should not be heat treated separately, but should be charged in the same annealing furnace at the same time with the casting, in order that it receive identical heat treatment with same. This is necessary in order to be assured that the physical results obtained from the coupon represent the physical properties of the casting itself.

Failures such as those just briefly cited might mislead prospective purchasers into believing the machinery itself was at fault. In cases of this kind, no reflection can be cast upon the make or design, because the failures are direclty due to the fact that the makers of the castings did not furnish a good product. It is always unwise to place an order for a special part to the lowest or any bidder, without first having been satisfied as to his ability to furnish a satisfactory product.

I believe I am safe in stating that the average mechanical engineer knows steel only in a general way, as he has neither the time nor the opportunity to keep up to date with the rapid advances made in this art. Even we who are working on this subject all the time, find it difficult to keep pace. An engineer will design a part and figure on a certain factor of safety, for example of 5 to 1, when he expects to encounter shocks, etc. With this factor of safety he may require steel of say 110,000 lbs. elastic limit, which predetermines an ultimate strength of approximately 140,000 lbs., but loses sight of the fact that to meet this high elastic limit the elongation and contraction will be relatively low, and he will have a steel lacking in ductility, so that the real factor of safety is actually much lower. For such a highly stressed part, he would have a more satisfactory product if he used a factor of safety of 4 to 1, and asked for a steel having, say, 90,000 lbs. elastic limit, with proportionately lower tensile strength, since he would have a corresponding increase in ductility, thereby enabling the part to withstand shock and vibration.

One big problem in some cement plants is to obtain satisfactory shafts for gyratory crushers. Low to high carbon steels and alloy steels heat treated for high tensile strength and elastic limit have been used, but certain plants still have more breakages than they should. I have been investigating this subject with a view to developing a satisfactory steel and a heat treatment for this purpose. In general, I find the tensile properties need not be high, but the important properties are elongation and contraction of area. The shafts which on the average stand up longest in service are those with greatest ductility.

I have interviewed a number of cement plant operators who use the gyratory crushers, and find such shaft failures are peculiar to certain plants, while others rarely if ever have this trouble. The plants which have no failures attribute their success to the fact that they make a special effort to keep dipper teeth, sledge hammers, and other iron and steel parts from going through the crusher. The penalty to employees allowing such parts to go through is dismissal. I am inclined to believe that this is one of the major reasons for shaft breakages, as this would explain why the harder shafts are more susceptible to failure than the softer and more ductile ones. When a large piece of steel passes through a crusher, something has to give, as the crusher itself cannot stall. If the liner plates do not break, the shaft must distort. A hard shaft will act as a spring, but the excesssive strain which has been put on some points, usually on the outside surface, will produce a nick of perhaps microscopic size, which we might call an incipient break, and during continued service it grows larger, finally resulting in the fatigue break, which these shafts manifest on fracture. The softer steel shafts will bend and at times even take a permanent set, but there is no doubt but that the increased ductility accounts for their being longer lived. When a plant has an unusual number of breakages of this nature, and if it is certain no foreign material has gone through the crusher, an investigation should be made by a competent party, as such a condition can generally be corrected either by a change of steel or by special heat treatment.

I understand some gyratory crushers are being redesigned in order to permit shortening of these shafts, and that these shorter shafts are reducing the breakages to a considerable extent.

I can easily imagine how the cement plant engineer, or the engineer building machinery, who might interview six to a dozen representatives from as many different steel concerns, could become confused when attempting to boil down the diversified information received. The same thing would happen if the writer were in the market for cement, and with his limited knowledge of this product would have difficulty deciding whose cement was best after interviewing representatives from as many cement companies. I would probably purchase from the lowest bidder, and no doubt obtain just what I paid for, namely, an inferior product. The enthusiastic steel salesman may elaborate on the wonderful physical properties of a special alloy steel, representing results obtained from a small test bar, and leave the cement engineer to believe that these results can be obtained in a 15-in. or 20-in. diameter forging. Were the engineer to attempt to purchase a forging requiring such high properties, the reliable steel manufacture would try to discourage such requirements, but the engineer might find some one hard up for work who would try to furnish it, and the chances for its giving satisfactory service would be very slight.

I believe I am safe in stating that cement machinery must stand as much or more abuse than machinery for most other industries, on account of the abrasive materials handled, and the considerable amount of dirt and dust always found in the cement plant, which becomes embedded in bearings. Some parts must stand both wear and shock, and some must stand either shock alone or wear alone. In the case of parts which must stand both wear and shock, a happy combination can be obtained by means of case hardening the outside surface, which will resist wear, retaining a strong and tough core to resist shock. In the case of a part which is not subjected to shock, this can be made of a steel which can be hardened throughout. In the case of a part which must stand severe shocks and vibrations, certain steels can be specifically heat treated to stand up for this service. It is my impression that certain parts, such as gudgeons, liner plates for tube mills and crushers, are expected to wear out in a certain length of time, and replacing material is ordered without investigating the possibility of obtaining a material which will give double the service or better. It seems that breakages and excessive wear are accepted as a matter of course by many cement plants. There are manganese steel castings made which stand up best under certain conditions at one plant, while some other special steel casting or forging will give better service at another plant. Each plant has its own individual problems, which can be worked out by the proper cooperation with reliable steel manufacturers.

Take pinions, for example. Cast iron pinions are cheapest if the first cost is considered only. Occasionally a cast iron pinion makes an exceptional record, but how often is a cast iron pinion obtained which wears out or breaks in a short time, usually breaking before being worn out, and where the cost of labor and curtailment of production on account of repairs would make the ultimate cost considerably higher than if good special steel, heat treated pinions had been purchased in the first place.

Satisfactory iron or steel for almost any purpose can be obtained if the manufacturer is acquainted with full details concerning requirements, and if he is paid the price. No matter what the commodity is, we generally receive the quality we pay for. When a cement company wishes a forging and is only willing to pay a certain limited price per pound, it will receive a forging which is worth the price paid for it and no more, since in order to make a forging at such a figure the steel manufacturer will have to select his steel accordingly, and perhaps at this price he cannot afford to heat treat it. If a forging is required, payment of a fair price to a reliable manufacturer will secure a special steel properly selected, and will insure careful heat treatment for the service required. Though such a forging might cost three times as much per pound, it would probably last more than three times as long; but if it outlives the lower priced forging only 2½ times it would be cheaper in the end, on account of continued operation during this extended period and saving on cost of taking down and reassembling.

In the case of the steel casting failures on the jaw crushers, mentioned earlier in this apper, these castings would no doubt have been cheap at 50 cents a pound if they had not broken.

The cement engineer should work closely with the steel plant metallurgist, and the cement plant purchasing agent should work closely with the cement engineer. In cases where the purchasing agent does not cooperate with the engineer, he will buy steel other than that specified by the engineer if he can obtain a reduction in price. This reduction in price may be quite costly, due to curtailment of production and cost of repairs on account of break-downs. If there are parts which break or wear out too soon, the cement plant should look for something to give better service and go to a reliable source of supply, state what is wanted, with a complete history of the average service obtained from past material, and details of its iron or steel composition. With such information, the metallurgist should be able to recommend iron or steel which would be more satisfactory, and while many times he may recommend a steel which will cost somewhat more, sometimes he finds a high priced steel being used where a much cheaper steel would have given as good or better service.

Before closing, I wish to emphasize the importance of cooperation between the cement engineer or the engineer building cement machinery, and the steel plant metallurgist. In our corporation we find it valuable for our plant engineers and engineers who are designing or building machinery to keep in constant touch with our metallurgical departments. When they design a machine to perform a certain operation, they first consult the metallurgists to determine which steel will best stand up in service, and the physical properties which can be obtained from this steel, and they then design their machinery accordingly. In some plants the designing engineer will design his machinery independent of metallurgical advice and make some parts so light and at the same time requiring extremely high physical properties, that he works a hardship on the metallurgical and heat treating departments, which must resort to the use of high priced alloy steels, which may be very sensitive to heat treatment, and which may crack and distort during the drastic heat treatments needed to obtain the extremely high physical properties. This results in high shop loses and often in the installation of defective parts, causing failure in service. Where there is close cooperation between the engineer and metallurgist, such a condition is not likely to occur, and although the machinery may be somewhat heavier, it will be more efficient. The metallurgist finds it necessary many times to consult with the engineer before recommending steels for certain parts, in order to become acquainted with the exact details of the duty which the particular parts are to perform. We find in our corporation that neither can get along without the other, and certainly this same condition must hold true with the cement industry or any other industry using iron or steel.

Bricks From Dolomite

Standard size bricks have been made at the ceramic experiment station of the Bureau of Mines, Columbus, Ohio, from calcined dolomite and from raw dolomite, using 10% of the flux Fe_2O_3, Al_2O_3, SiO_2. The calcined dolomite was found undesirable for making into bricks as the mud slakes so rapidly, and on account of enormous shrinkage during drying and burning all samples cracked badly. Raw dolomite, together with 10% flux, is reported to give excellent promise, however. The bricks so burned to 1,450° C. were sound, of high density, and have not shown signs of slaking when subjected to a boiling test.

Only two cement companies are operating in New South Wales, the Commonwealth and the Kandos Cement companies. The Government uses about a million bags per year. The Kandos company mines all of its material on its own property, including coal.

The name of the New South Wales Cement, Lime & Coal Co., Ltd., of Sydney, has been changed to the Kandos Cement Co., Ltd.

Why It Pays to Read Your Trade Paper

By W. F. Schaphorst

Editors of trade and technical publications are continually on the lookout for material that will benefit the reader.

Anything new or anything better is always welcome, because it is bound to be of interest to every *live* reader of the publication. The subscriber who merely subscribes and does not bother to remove the wrapper from his paper, and who says "I never have time to read my papers," might as well save the price of the subscription. He certainly is not a *live* reader. He does not obtain any benefit from the good things published in every issue. Every issue invariably does contain good and valuable pointers.

For example, an acquaintance of mine went into business, a couple of years ago, and invested all of his money in the business. It was his belief that by working day and night, Sundays and holidays, and keeping everlastingly at it, he would undoubtedly succeed in accordance with the old doctrine that all of us have heard time and again. But hard work isn't everything. It is all right if it is done intelligently—if the hard work is supplemented with clear thinking and good judgment. Practice, alone, is not enough. Theory must be mixed with practice.

This friend of mine subscribed for a number of publications, but he did not read them. He did not have time, so he said. In his business dealings, time after time, he made mistakes—costly mistakes—which could as well have been avoided had he been a regular reader of the trade publications that he received. The time he wasted in learning his business through actual hard knocks and experimentations, would have been ample to read all of the publications he received from cover to cover—and then some.

All of the money he lost, due to his mistakes, would have purchased hundreds of subscriptions and enough technical books to fill a good-sized room.

However, he could not see it that way. He would not deviate one degree from the hard experience route that he had selected for himself. He was determined to see it through.

He didn't see it through. He failed.

Every person who has a profession or business of his own, who works at a trade, and who is anxious to advance, should read the best publications in his field regularly. The business man who does not read, and who leaves the valuable kinks and the new methods to his competitor who does read, will be handicapped greatly if he wishes to progress as rapidly as his competitor.

Every time your competitor reads about a money-saving or money-making kink, which he applies in his business and which you do not apply in yours because you do not know about it—it is perfectly plain that you are simply lagging that much behind.

Reading your trade publications not only improves your mind, but eventually it is bound to improve your pocketbook as well.

A long series of experiments and a study by W. Krebs of the work of previous investigators have shown that all basic blast furnace slags in a glassy, granulated state can be converted into hydraulic cements by the addition of alkali minerals and gypsum. Such cements harden better than is required by the (German) standard specification, and they are unaffected by three months' storage.

Men and Mills

Notes from the Field

The Indiana Portland Cement Co., Greencastle, Ind., has recently installed a Fuller-Kinyon pump to convey the finished cement from the grinding department to the silo storage bins. The company is also putting in a Fuller-Kinyon pump in its coal grinding department to supply coal to the kiln bins, which line will eventually be extended to supply pulverized coal to the boiler furnaces.

The Bohemis Portland Cement Co., a German company, has declared a dividend and 10% bonus, according to the *New York Herald.*

With the increasing operations at plant No. 2, on June 22, the Lehigh Portland Cement Co.'s three mills in the vicinity of Newcastle, Pa., were placed at capacity operation.

The Kelley Island Lime & Transport Co., at the recent directors' meeting, following the annual stockholders' meeting, elected the following officials:

Chairman of the board, John A. Kling; president, George R. Johnson; first vice-president, E. W. Oglebay; second vice-president, F. A. Beckwith; third vice-president and general manager, G. J. Whelan; fourth vice-president, F. W. Ohlemacher; secretary and treasurer, C. A. McMorris; assistant general manager, A. B. Mack; assistant secretary and assistant treasurer, F. W. Kuhl; auditor, J. W. Longdon.

Executive Committee: John A. Kling, chairman; George R. Johnson, H. M. Hanna, Jr., John Sherwin, John E. Morley, H. G. Dalton.

Other officers are: Sales manager, Henry Angel; assistant sales manager, F. M. Pinnegar; purchasing agent, Victor Price; traffic manager, J. F. Potts.

F. W. Ohlemacher, who was elected fourth vice-president, has been in charge of the company's vessels and Sandusky department for many years.

A new safety competition started the Speed, Ind., plant of the Louisville Cement Co., on July 2 and will last through September 23.

Six safety divisions have been organized for the race.

The plant of the Standard Portland Cement Co., at Napa Junction, Cal., is finally being dismantled. All machinery that can be used at the Santa Cruz plant will be shipped there and the remainder sold.

Cement for the new Nebraska state capitol building which will cost about $5,000,000, is being furnished by the Nebraska Cement Co.

C. E. Ford, who for the past several years has been with the Chicago Pulley & Shafting Co., has recently joined the engineering sales force of W. A. Jones Foundry & Machine Co., manufacturers of speed reducers and power transmitting machinery. In the near future Mr. Ford will be located in Minneapolis as manager of the Jones branch there.

A serious accident occurred at the Tidewater Portland Cement Co.'s plant, when Ed. Smith was struck on the face with a switch lever. The accident occurred when he attempted to throw the switch, when the car was about ready to enter the frog.

Richard K. Meade returned to Baltimore late in June, after a trip to the Pacific Coast, where he made a survey of gypsum deposits in that locality.

H. S. Van Scoyoc, manager of publicity for the Canada Cement Co., Ltd., recently returned to Montreal after an extensive trip through the west.

W. H. Kent, vice-president and general manager of the Weller Manufacturing Co., left Chicago on June 28 for an extended trip throughout the European countries. Investigation will be made as to the possibilities of future trade, also inspection of Weller equipment installed in a number of the large plants. At the present time there are a number of projects contemplated, in which elevating, conveying and power transmitting machinery will be an important factor.

With the operation of Mill A, of the Lehigh Portland Cement Co., every mill in the Lehigh cement region is working, making a capacity production of cement for the first time in years. The cement is being shipped almost as quickly as it is made, and an excellent demand is being encountered.

Prospects are good for continuous operation, and most of the mills were well supplied with bituminous coal in July.

The Wisconsin highway commission went on the Chicago cement market in search of cement on July 10, according to reports from Madison.

Fifty thousand barrels will be bought at market prices, or perhaps higher, for immediate delivery following failure of the Marquette Cement Mfg. Co. to deliver 60,000 bbls. contracted for delivery to various projects over the state during May and June.

The cement bought by the state now will cost from 23 to 40 cents a barrel more than that purchased from the Marquette company, which underbid all other mills 10 cents a barrel. The jump in cement prices in the last two months, since the state contracts were signed, will cost the state around $20,000, it is estimated.

George W. Weitkneckt, of Northampton, died recently at his home, after a short illness due to a complication of diseases. In the death of Mr. Weitknecht Northampton lost one of its prominent citizens, the Lehigh Portland Cement Co. one of its most trusted employees. About 30 years ago, when the cement industry was in its infancy, he became connected with mills in the Lehigh region in the capacity of concrete construction foreman, and helped in the erecting of many of the mills.

Final settlement in the case of the Coosa Portland Cement Co., bankrupt cement manufacturers of Ragland, Ala., was made July 7, according to the *Birmingham News*. The National Cement Co. has purchased the plant of the bankrupt firm, which has been in the hands of receivers for several years.

The National Cement Co. has been negotiating for the purchase of the plant for some time. With the closing of the deal all property and holdings of the bankrupt firm were transferred from the bankrupt court to the new owners.

The plant at Ragland is valued at more than $750,000, and is one of the largest in Alabama, having a capacity of 90,000 bbls. a month. Pending final settlement, the National Cement Co. has been operating the plant during the past year.

An entirely new crusher plant is being installed at the Tidewater Portland Cement Co.'s plant. The structure is being erected south of the present crushing plant, near Union Bridge, Md.

The Susquehanna Collieries Co., at Lykens, Pa., has just placed an order for two additional 42-in. Fuller-Lehigh gear driven screen type mills, which will make a total of six 42-in. Fuller-Lehigh mills in the Lykens plant, pulverizing exclusively anthracite culm for their power plant, which consists of six 600 h. p. Edge-Moor boilers and six 500 h. p. Edge-Moor boilers. This is probably the largest plant in the world using anthracite culm exclusively as a boiler fuel.

The Sandusky Cement Co., Cleveland, Ohio, is installing three 42-in. Fuller-Lehigh screen type mills in its plant at Silica, Ohio, to be used in pulverizing coal for cement kiln and boiler fuel.

"Introducing the New Marquette Sack" is the title of a folder issued by the Marquette Cement Mfg. Co., Chicago, Ill. The new green and black sign of Marquette cement is being applied to the sack itself.

It is pointed out that the convenience with which Marquette sacks can be sorted will save time and eliminate confusion resulting from mixed sack shipments. Until the supply of former Marquette sacks is used up, Marquette cement will be shipped in both kinds of bags.

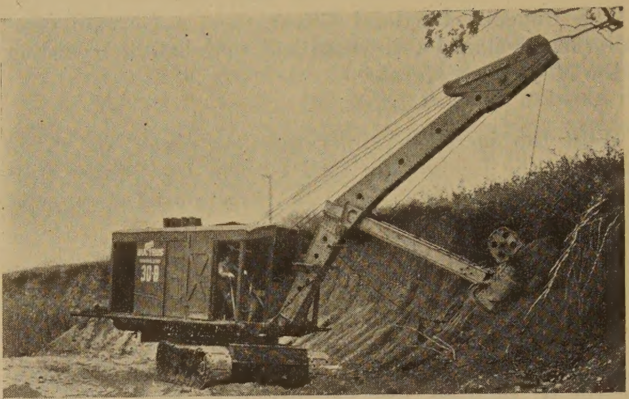
The 1922 National Exposition of Chemical Industries will be held during the week of September 11-16 at the Grand Central Palace in New York.

The Marquette Cement Mfg. Co., LaSalle, Ill., is installing one additional 42-in. Fuller mill as an extension to its coal grinding plant, this additional mill being necessary due to increased capacity.

Diesel Type Engine for Shovel

The shovel shown in the accompanying illustration, known as the Bucyrus 30-B oil shovel, will use as fuel any cheap, low grade oil of high heat value which will flow freely. It has been developed by the Bucyrus Co., South Milwaukee, Wis., from whom the following information has been received.

The engine is of the full Diesel type, not the semi-Diesel. It is what is known as a mechanical injection engine, develping 55 h. p. at the conservative speed of 360 r. p. m. Its cylinders are 8 in. by 10½ in. It is a heavy duty, slow speed engine of particularly rugged and heavy construction, adapted well to the severe service it must undergo in excavation work.

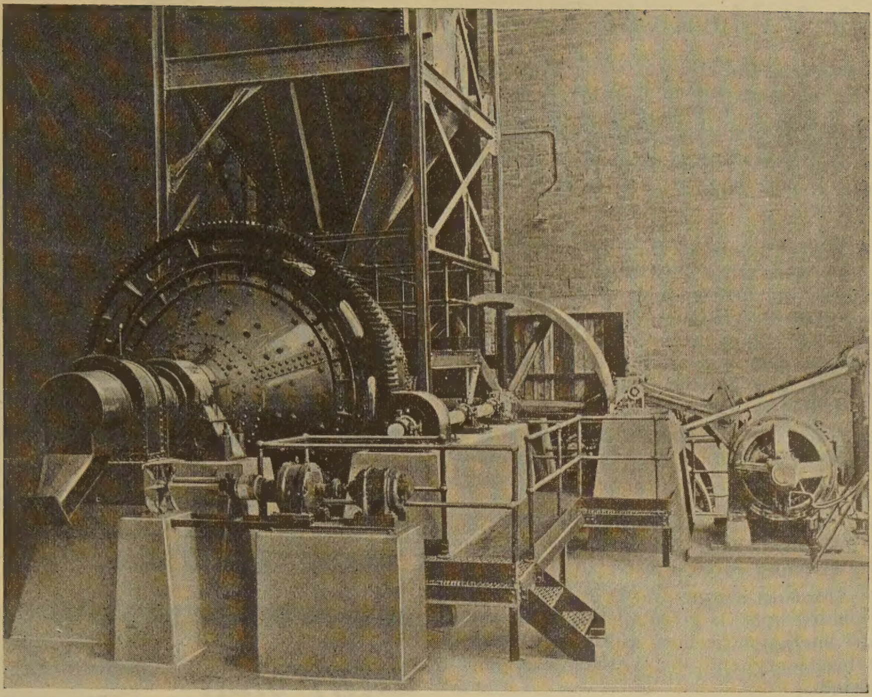


This Diesel type engine differs from the gasoline engine principally in that it is a constant pressure engine, the fuel being burned directly in the cylinders without the aid of a carburetor, spark plug or outside heating appliances. In the gasoline engine the mixture is taken into the cylinders, compressed, and then ignited by some auxiliary mechanism. The pressure then rises in the nature of an explosion. In the Diesel type engine the fuel is injected into the cylinders at a constant pressure in an atomized state. It is fired by the heat developed by the compression of air in the cylinders on the previous stroke. Thus the sudden pressure due to the explosions in the gasoline engine is eliminated, making the engine steadier running and easier to maintain.

The 30-B oil machine, equipped with a Diesel engine, may be furnished either as a shovel, a drag line, a clamshell, or a locomotive crane.

The Dominion Portland Cement Co., Whangarei, New Zealand, is now out of existence as such and has become a part and parcel of the Wilsons (New Zealand) Portland Cement Co., Ltd., of Portland, N. Z.

The Semi-Annual Index for CONCRETE, Vol. 20, January to June, 1922, is ready and will be sent, without charge, to all subscribers who ask for it. The Mill Section Index is printed separately.



A 10 ft. dia. Ball Mill is Grinding Clinker

The largest ball mill ever built is now grinding an extremely hard clinker from kiln run to all through 20-mesh at an average rate of 142 barrels per hour. This is a 10-ft. diameter by 48-in. cylinder Hardinge Conical Ball Mill. Its ultimate capacity on average clinker is still to be determined, for the conditions under which it is now working are the most severe that could possibly be found.

When you consider that the feed to the mill often exceeds 4″ and 5″ in size, that the clinker is high in alumina and very low in lime, the capacity of 142 barrels per hour is truly remarkable.

Figure out for yourself how many grinding units you would save by installing this huge, slow-speed mill in your plant. It looks as though this size mill will become standard among large cement companies who favor large units as they can count on these units running continuously without fear of shutdowns for replacements and adjustments.

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Trade Publications

Hill Collar Oiling Bearing, Bulletin 112—The Hill Clutch Co., Cleveland, Ohio. A six-page folder, 6 in. by 9 in. This bulletin is devoted to a description with accompanying illustrations of new Cleveland type Hill collar oiling bearing, furnished for all styles of standard rigid and ball and socket mounting. Drop hangers, post hangers, and base plates are included in the description.

A Job That Took a Million Years, or the "Tale of a Clam." This is the title of a very interesting illustrated booklet giving the story of the commonplace article, lime, with a most uncommon history. This story is written to help people realize what an important part lime plays in our daily life, and tells some of the intimate facts about the origin, manufacture and use of lime, facts gained in experience during 16 years as manufacturers and distributors of lime.

The book is 8½ in. by 11 in., 16 pp., with paper covers, and is published by the Ohio Hydrate & Supply Co., Woodville, Ohio.

Synchronous Motors, Bulletin No. 1124—By the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. This is a 20-page bulletin, 8 in. by 10½, in paper cover, illustrated.

A description of synchronous motors and their construction, illustrated by actual photographs, is given, and installations in various cement plants where synchronous motors are used in driving cement mill machinery and installations driving air compressors are included.

Dynamite, the New Aladdin's Lamp—Hercules Powder Co., 16 pp., paper cover, 6½ in. by 10 in. This paper, by T. W. Bacchus, vice-president Hercules Powder Co., Wilmington, Del., is reprinted from the *Hercules Mixer* for April and May, 1922. An interesting comparison is made between the early methods of travel and work, and present day methods, much of the progress being attributed to the aid of dynamite. Numerous instances are pointed out where dynamite does the bidding of man and causes nature's vast stores to yield their treasure.

Eliminating Waste in Blasting, by N. S. Greensfelder, published by the Hercules Powder Co., Wilmington, Del. This is a 56-page book, size 6 in. by 9 in., paper cover, illustrated, with photographs and diagrams.

Information is given as to how some progressive companies are preventing waste in blasting, and recommendations are also given by the Hercules company. There are chapters on Planning the Work; Drilling; Choice of Explosives; Advantages of No. 8 Blasting Caps; Use of Stemming; Preventing Waste in Firing.

Those interested in blasting may secure a free copy of this book upon request to the advertising department of the Hercules Powder Co.

A rotary kiln patented by J. S. Fasting and assigned to F. L. Smidth & Co., is provided with a cooling device for the clinker, consisting of an annual chamber coaxial with the kiln, open at one end and communicating at the other with a chamber at the end of the kiln, through which clinker travels longitudinally after discharge from the kiln. Cooling air, in excess of that required for combustion in the kiln, is introduced into the open end of the annular chamber, the excess passing from the chamber at the end of the kiln.

In a process for the recovery of potash salts in cement manufacture, patented by E. O. Rhodes and R. C. Haff, and assigned to the Western Precipitation Co., a potash-bearing cement mix is clinkered by direct firing, the fuel being separately introduced. The formation of potassium compounds of low solubility is restricted by supplying to the kiln atmosphere a suitable compound of a metal forming an alkaline oxide, and also a substance which assists its action. The potash is recovered from the exit gases.

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